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Using ePortfolios to Develop and Assess ABET-Aligned Competencies

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Abstract

The Agricultural and Biosystems Engineering (ABE) Learning Community is using electronic portfolios (ePortfolios) for developing and assessing student competencies. These competencies are part of the Iowa State University's (ISU) College of Engineering competency-based assessment program for ABET student outcomes. ABE students in their second semester English composition (rhetoric) course (exclusive to ABE Learning Community students) use electronic portfolios to present arguments on issues relevant to engineering and agriculture. This paper will discuss the extensive collaboration between the English instructor and ABE faculty in constructing the course objectives and syllabus, the process by which ABE students create their ePortfolios, how the ePortfolios are assessed, and how ePortfolios contribute to the development of ABET-aligned competencies.

Introduction

In our department, the umbrella term "Agricultural & Biosystems Engineering Learning Community" has evolved to now encompass two complementary undergraduate programs available to our first- and second-year undergraduate students who are majoring in agricultural engineering or agricultural systems technology: the ABE *learning* community, which is created by having students co-enroll for specially selected linked courses, and the ABE *living learning* community, a reserved portion of a specific residence hall. Other features of the ABE learning community include peer mentors and tutors, faculty-student dinners, and student service learning opportunities. The ABE Learning Community has been described in detail in previously published papers.[1, 2, 3]

We see the ABE Learning Community as key to helping us achieve the intended student outcomes of our programs. These outcomes were developed to meet the ABET Criteria 2000. ABET Criterion 3, Program Outcomes and Assessment, states, "Engineering programs must demonstrate that their graduates have…" and presents a list of eleven specific outcomes, now well known as ABET (a-k) Outcomes[4]. At Iowa State, we decided that the ABET (a-k) Outcomes are too complex to measure directly.

Accordingly, we identified fourteen unique "ISU Competencies" as necessary and sufficient to measure the ABET (a-k) Outcomes.[5, 6] The fourteen ISU Competencies have been mapped to the ABET (a-k) Outcomes that we adopted for the ABE program and validated through engagement with contributing constituents (Table 1). Each of the ABET-aligned Competencies has an independent set of observable and measurable Key Actions (Table 2). A web-based assessment tool for the Competencies and related Key Actions is now in use for students in cooperative and internship experiences[7].

Beyond the cooperative and internship environments, we believe that student electronic portfolios (ePortfolios) can demonstrate and help develop at least six of the fourteen ISU Competencies: General Knowledge, Initiative, Innovation, Planning, Communication and Teamwork. In the first-year composition course for the ABE Learning Community, we had student teams develop ePortfolios in which they would develop and demonstrate these competencies.

ePortfolios

First, our decision for using ePortfolios comes out of our desire to have a broader assessment tool for student intellectual development and technical expertise. We believe that the portfolio process is a successful paradigm for broader assessment because student are given the choice to collect certain examples (papers, reports, projects, and autobiographical information), reflect on the significance of these examples, and to explain their selection process for the instructor and/or audience. When done correctly, the portfolio as an educational artifact shows intellectual growth and gives the assessor of this growth a range of performances that indicate the student's intellectual and technical development[8].

Second, we believe that engineers and technologists must know how to convey complex information in a manner that helps the audience, including non-engineers, to understand the technologies and concepts being used. Electronic environments heavy with multimedia are becoming every more prevalent on both our televisions and computer screens. Students in general will be faced with complex choices when it comes to addressing audiences with their ideas, messages, and arguments. Electronic portfolios (ePortfolios) are ideal vehicles for helping students negotiate multimedia environments by giving them access to the programs that create the electronic environments, and then having them wrestle in the present with the types of media choices they will increasingly need to make as professionals in the future. As Kathleen Blake Yancey indicates:

> *The electronic environment, whether a disk or a Web page, offers multiple opportunities for representing learning. Students can include performances through sound and video; they can show multiple ways of understanding through graphical, numerical, and verbal representations of data; they can link these representations one to the next or all at once; and they can provide multiple points of entry for different audiences into the various exhibits* [9].

Collaboration

English 105 is a required second-semester composition class focusing on rhetoric and theories of argument. Within the ABE Learning Community (reference), the function of English 105 is to raise ethical issues in agriculture, engineering, and technology, and let students explore the issues through writing essays. Before starting of spring semester 2002, the coordinators for the ABE Learning Community and the English 105 instructor met and discussed our goals for the course, and how we would collaborate throughout the semester to monitor progress and make changes.

We decided that the freshmen needed an experience that would challenge their views on the world, agriculture, and technology. We had the students read Aldo Leopold's A Sand County Almanac and various essays on biotechnology, consumer culture, constructions of myth in American culture, and gender studies. We invited the Leopold Center for Sustainable Agriculture (www.leopold.iastate.edu) and John Deere Corporation to speak to our students from the different perspectives that they occupy within the field. Dr. Fred Kirchenmann, the Leopold Center Director, came to the English 105 sections to speak about systems theory and agriculture. Greg Gookin, Manager of Training Worldwide for John Deere, discussed their marketing strategies and corporate communication policies, and also the utilization of GPS systems for increased mechanization of agriculture. Students also took part in two seminars sponsored by the Leopold Center in which Mr. Takao Furuno, a sustainable agriculturalist from Japan, explained his growing system and speculated on the potential for developing similar sustainable agriculture systems in Iowa's ecosystem.

We also decided that our students needed a technological literacy with 21st century technologies, and that this literacy could be best accomplished through an electronic portfolio assignment. This meshed well with our previous conceptions of student competencies. The ABE Learning Community purchased Macromedia's Dreamweaver web editor for the computer labs. We also purchased Macromedia's Flash to teach the students about both static and animated visual arguments. The students would be expected to take these tools and use them to start building electronic portfolios showcasing their intellectual and technical capabilities. The goal was to have the students begin to see patterns in the stories that they and their cultures use, and in the communication tools used to construct our individual and collective meanings in the context of the issues covered in the readings and presentations.

As the spring 2002 semester progressed, we met regularly to discuss the class, the students' progress, and implementation of the authoring software. Adjustments in the course (e.g., more or less emphasis on certain topics, reworking the schedule, etc.) were made as needed.

ePortfolio Assignment and ABET-aligned Competencies

Over the course of the spring 2002 semester, students were asked to keep a journal of their thoughts on issues coming out of the readings in the class. The students were encouraged to write about their own reactions to the readings, but the instructor also provided journal questions coming out of group discussions held in the classroom. Periodically, the reading journals were collected to assess the individual student's writing and thought process. By the end of the semester, most students had 9 to 12 pages of reflection on current agricultural and technology issues as they begin the construction of the electronic portfolio. Students examined current issues such as bioengineering, mechanization of agriculture, and consumer perceptions of technology and engineering, and they are explored their feelings and opinions on these issues as a member of a technical discipline. This part of the assignment addressed the **General Knowledge Competency** by having the students think about current issues and events and how they might impact their discipline.

The students were assigned to groups of three and asked to create a hypermedia document using their reading journals as a starting point for the content. This addressed the **Teamwork**

Competency – students had to learn and negotiate how to accomplish goals as a team, involve all team members, keep other team members informed, and model commitment by fulfilling responsibilities and demonstrating commitment to the team.

Note that this assignment was a "classroom" portfolio, and not a summative or professional portfolio[10]. It focused on the issues and topics in the class, and was not meant to summarize or demonstrate students' overall skills, proficiencies or talents.

Initially in the assignment, we used templates to help the students begin to see how different elements of the electronic portfolio could come together, and the first few pages that they created were mostly boilerplate. We believe, however, that templates are only a starting point for helping students create their electronic portfolios and should not become a rigid standard from which all student work is judged. This addressed the **Initiative Competency**, where students take independent action and going above and beyond what is required. Most students departed from the original templates and created unique designs and architectures.

Students were asked to create multimedia arguments using sounds, images, rollovers, and animations based on issues that come out of their reading journals. Therefore, we consciously crafted our system by including the multimedia component to encourage the students to use creative innovations to explore their ideas in their portfolios. This addressed the **Innovation Competency**. They had to rethink their arguments in a different media, make connections between disparate ideas, view situations from multiple perspectives, and draw upon multiple and diverse sources for ideas and inspiration.

Because each student brought 9 to 12 pages from their reading journal to the portfolio project, the group needed to incorporate at least 27 to 36 pages of material in a way that was organized, argumentative, and coherent. This was the major challenge of the electronic portfolio project and related to how the Internet itself is structured. The web works by having disparate ideas connected through information architecture (links, headings, color coding, page design etc.), and students needed to learn the different strategies in bringing these ideas together in electronic environments. This addressed the **Planning Competency,** where students identify critical issues and tasks, allocate tasks and schedules, and take advantage of each individual's skills and talents.

Perhaps the most obvious competency addressed in this assignment was the **Communication Competency.** The students needed to make their arguments in hypermedia in a manner that engaged the audience and help them understand and retain their message. Many communicative elements had to seamlessly come together, such as information architecture, visual design, written texts, multi-media presentations, and the general theme of the portfolio itself. They had to organize the portfolio, create elements to maintain audience engagement, and adjust their portfolio to their audience. They had to adhere to the accepted conventions of hypertext media theory.

One aspect of the Communication Competency that was perhaps unexpected was the communication that occurred within the teams. They had to negotiate amongst themselves about what would be included or left out. They had to work to ensure understanding among the team members. Listening to each other was critical to the success of their team.

In order to create these ePortfolios, students learned basic hypertext and media theory in the class. They also learned how to use Macromedia's Web Suite (Dreamweaver, Flash, Fireworks, and Freehand) as authoring tools for the project. This took approximately four weeks of the semester. We chose Macromedia's products for a variety of reasons. First, we were looking for something that would give our students the freedom to create powerful and interactive websites with a learning curve that was manageable in one semester. Macromedia's products met our needs by providing excellent online tutorials, online support groups, and templates to help our students negotiate the initial skills that they needed. Second, we found it easy to supplement the Macromedia tutorials with our own online lessons on the software to target specific skills for our students to learn such as the incorporation of video and sound files into HTML and Flash formats.

Many of the tutorials that come with the Dreamweaver and Flash programs tend to build their lessons around accumulated long-term projects. Although they are still useful for helping students learn aspects of the different programs, we found that creating our own tutorials (www.learn.abe.iastate.edu/tutorals) provided much needed extra assistance with minimal effort. Undergraduates who already knew the programs were hired as peer mentors and helped create the online tutorials. Later, these same peer mentors were used as aids in class to help the students learn and use the software. We also found shorter tutorials on the Internet created by web developers and used them for specific tasks for different groups of students.

Note that the journals and portfolios often contained copyrighted material (songs, videos or images that the students own). We could not publish the electronic portfolios on the web unless the students had obtained appropriate copyright permission, and none of the students obtained that permission. Therefore, the students placed their portfolios on a CD for the instructor to view in order to remain within fair-use guidelines. Because of this, we unfortunately cannot provide URLs for reviewing the ePortfolios the students created.

Assessment

Within the scope of the composition class, the ePortfolios were judged based on four major criteria: information architecture, visual design, development of written arguments, and use of multimedia to explore issues. Additionally, each student wrote a rhetorical analysis of their ePortfolio in which they discussed the portfolio process, including individual and group responsibilities with the project. Besides understanding the hypermedia theories used in the construction of the document, we also expected the students to address three key areas of the ePortfolio process: collection, reflection, and selection[10]. Inevitably, some material did not make it into the ePortfolio for a variety of reasons, and even the material that the students did use was significantly different in both form and character after going through the portfolio process. We wanted to understand the students' decisions on the shape of the ePortfolio. We also wanted students to reflect on how they perceived the collection of materials in the portfolio, and how they negotiated the selection of those materials.

We found that the ePortfolio assignment, while designed as a "classroom" portfolio, did indeed demonstrate and develop the ABET-aligned Competencies. We did not make a formal

assessment of Competencies for each student. Quite honestly, this approach had never been used in a composition class at Iowa State and we were focused on the mechanics of the process more than longer-term assessment. However, we have conducted a qualitative study (focus groups) with selected students and will be presenting those results in another paper.

We envision two ways that we will use these ePortfolios in the future. First, we will archive the students' ePortfolios for our ABET accreditation process, where they can be used to demonstrate our efforts and successes in developing student competencies. Second, we will implement the web-based competency assessment tool that is being used in other areas of our program[7] for future ePortfolios. This tool will allow us to make quantitative appraisals of student competencies on this assignment that can be added to overall program assessments.

Conclusion

The ePortfolio assignment provided a challenging and exciting way for students to develop ABET-aligned Competencies. It gave them the chance to develop technological literacy with 21st century technologies. Collaboration between the faculty coordinators of the ABE Learning Community and the English instructor was key to its success. Assessment was made in the context of the composition course, and more formal Competency assessments will be used in the future to document and guide the achievement of intended student outcomes for ABE teaching programs.

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Table 1. Intended student outcomes and mapped ISU Competencies of the ABE program.

ABET OUTCOMES VERSUS ISU COMPETENCY MATRIX

Engineering Criteria 2000 Criterion 3 Program Outcomes and Assessment		ISU Competency: Engineering Knowledge	General Knowledge	Continuous Learning	Quality Orientation	Initiative	Innovation	Cultural Adaptability	Analysis and Judgment	Planning	Communication	Teamwork	Integrity	Professional Impact	Customer Focus
(a)	an ability to apply knowledge of mathematics, science, and engineering	✘		✘		✘			✘						
(b)	an ability to design and conduct experiments, as well as to analyze and interpret data	✘		✘	✘	✘	✘		✘	✘		✘			✘
(c)	an ability to design a system, component, or process to meet desired needs	✘		✘	✘	✘	✘	✘	✘	✘	✘	✘			✘
(d)	an ability to function on multidisciplinary teams					✘		✘	✘	✘	✘	✘	✘	✘	✘
(e)	an ability to identify, formulate, and solve engineering problems	✘		✘	✘	✘	✘		✘		✘	✘			✘
(f)	an understanding of professional and ethical responsibility		✘	✘	✘			✘	✘				✘		
(g)	an ability to communicate effectively		✘			✘					✘			✘	✘
(h)	the broad education necessary to understand the impact of engineering solutions in a global and societal context	✘	✘	✘				✘	✘						
(i)	a recognition of the need for, and ability to engage in, life-long learning			✘		✘									
(j)	a knowledge of contemporary issues		✘	✘				✘	✘						
(k)	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	✘		✘	✘	✘		✘	✘						

Table 2. The six ISU Competencies addressed in the ePortfolio assignment.

ISU Competency	Definition	Key Actions
General Knowledge	Having achieved a satisfactory level of knowledge outside the areas of mathematics, science and engineering	• Demonstrates a knowledge of important current issues and events. • Relates general knowledge to engineering.
Initiative	Taking prompt action to accomplish objectives; takin action to achieve goals beyond what is required; being proactive.	• Responds quickly • Takes independent action • Goes above and beyond
Innovation	Generating creative, non-tradition engineering solutions in work situations; trying different and novel ways to deal with work problems and opportunities.	• Challenges paradigms • Leverages diverse resources • Thinks expansively • Evaluates multiple solutions • Ensures relevance
Planning	Effectively managing one's time and resources to ensure that work is completed efficiently.	• Prioritizes • Makes preparations • Schedules • Leverages resources • Stays focused
Communication	Clearly conveying information and ideas through a variety of media to individuals or groups in a manner that engages the audience and helps them understand and retain the message.	• Organizes the communication • Maintains audience attention • Adjusts to the audience • Ensures understanding • Adheres to accepted conventions • Comprehends communication from others
Teamwork	Effectively participating as a member of a team to move the team toward the completion of goals.	• Facilitates goal accomplishment • Involves others • Informs others on team • Models commitment